CHAPTER 2

NON-MEDICAL NUCLEAR, BIOLOGICAL, AND CHEMICAL WARFARE DEFENSE REQUIREMENTS AND RESEARCH AND DEVELOPMENT PROGRAM STATUS

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2.1 INTRODUCTION

This chapter provides a consolidation of Joint Service non-medical NBC defense requirements and an assessment of these programs to meet the needs of the Force. The discussion of both requirements and the status of research and development assessments is conducted within the framework of the three principles of NBC defense doctrine for the mission area, shown in Table 2-1.

Table 2-1. Principles of Chemical and Biological Defense Doctrine

• **Contamination Avoidance**
• **Protection**
• **Decontamination**

Continued proliferation of NBC weapons creates a continuous need to ensure that U.S. forces can survive, fight, and win in an NBC threat environment. The ever increasing danger from these weapons demands that we look for every opportunity to avoid technological surprises. When doctrinal, training, or organizational solutions (non-materiel solutions) cannot be found, new equipment solutions are sought through the materiel acquisition cycle. The evolving operational requirements demand that the Joint forces progressively capture and leverage advances in technology to provide the best in NBC defense equipment for the forces. We must continue to build upon the fundamentals of NBC defense doctrine.

As defined in Joint Pub 3-11, *Joint Doctrine for Nuclear, Biological, and Chemical Defense*, contamination avoidance includes detecting, avoiding, and bypassing contaminated areas. Protection consists of individual and collective protection. Decontamination restores combat power.

The key to the successful implementation of research, development, and acquisition (RDA) strategy is the concept of continuous incremental investment. Our RDA goal is to equip the Force with world-class equipment in sufficient quantities and in the shortest time possible in order to win decisively, quickly, and with minimal casualties. As authorized under the Joint Service Agreement for non-medical programs and Armed Services Biomedical Research, Evaluation and Management (ASBREM) Committee for medical programs, the Army as executive agent coordinates, integrates, and reviews the DoD NBC defense program. The results of these reviews, conducted with all Services participating, are documented in the Joint Service Modernization and Joint Service RDA Plans. These documents form the basis for the consolidated NBC defense Program Objective Memorandum (POM).

The Services in coordination with the Commanders-in-Chief (CINCs) decide if a materiel solution is needed to solve the requirement through the process of requirement identification and analyses. If a valid requirement exists, then the research and development modernization process will identify improved technology approaches which may provide a new system or upgrade an existing system. Continuous modernization is the strategy used to sustain and

enhance the capabilities of our forces within our acquisition system—personnel, industrial base, infrastructure, and programs.

In accordance with our national strategy of achieving and applying technological superiority, several underlying concepts form the foundation of acquisition modernization. The first is the need to reduce cycle time in the acquisition of new systems or the integration of emerging technologies into existing systems. The use of Advanced Concept Technology Demonstrations (ACTDs), open systems and architectures, along with the new emphasis on commercial standards and practices, allow us to shorten the acquisition cycle time. Our programs must reduce the overall cost by using concepts such as design-to-cost and concurrent engineering to ensure that equipment is easy to maintain and repair even with the inherent complexity seen in the majority of new systems.

2.2 NBC DEFENSE MISSION AREA REQUIREMENTS AND RDA SUMMARY

Over the past two years, the Services have been working closely to increase the jointness in ongoing programs. This report highlights improvements during FY96 and discusses cooperative efforts for further Joint development of requirements. This section is a summary of the requirements in each of the mission area tenets. Tables 2-2 through 2-10 provide a consolidation of requirements and acquisition strategies. Since the focus of this chapter is on research and development efforts, fielded items are not included in these tables. Descriptions of fielded equipment can be found in annexes A–D at the end of this report.

2.3 CONTAMINATION AVOIDANCE (Detection, Identification and Warning)

NBC reconnaissance, detection, identification, warning and reporting are the essential elements of contamination avoidance. Early warning is the key to avoiding NBC contamination. Sensors for the individual joint task force member and systems capable of detecting multiple agents and characterizing new agents are being developed. Advances in technology are being pursued in chemical and biological standoff, and remote/early warning detection, miniaturization, lower detection limits, logistics supportability and affordability. The following sections detail contamination avoidance science and technology efforts, modernization strategy, and Joint Service programs.

2.3.1 Contamination Avoidance Science and Technology Efforts

2.3.1.1 Goals and Timeframes. The goal of contamination avoidance is to provide near real-time capability to detect, identify, locate, quantify, and warn against all CB warfare agent threats below threshold effects levels (see Table 2-2). Science and technology efforts currently emphasize multi-agent sensors for biological agent detection and remote/early warning CB detection. To meet near-term needs, a number of individual sensors are being developed while detection technology matures. Far-term objective technologies will allow integration of chemical and biological point and remote/early warning detection modules into a single system. The technology focus is on detection sensitivity across the evolving spectrum of CB agents; systems size/weight, range, signature and false alarm rate; and integration of CB detectors into

various platforms, individual clothing, and command, control, communication, computer, and intelligence (C^4I) networks. Detector technologies based on olfactory-like chemical sensing and molecular approaches to optical sensors offer long term opportunities.

Table 2-2. Contamination Avoidance Science and Technology Strategy

By 1997	By 2002	By 2007
• Demonstrate improved chemical standoff detection from ships • Demonstrate improved reconnaissance capability • Joint Chemical Agent Detector (JCAD) downselect between Surface Acoustic Wave and Mini-Ion Mobility Spectroscopy (Mini-IMS)	• Demonstrate integrated point biodetection capability (Advanced Technology Demonstration) • Complete fabrication of tunable, eye safe laser for standoff detection • Field (eye safe) Long Range Bio Stand-off Detector in FY99 or FY00. Schedule may slip depending on possible restructure after Congressional cut. • Complete development of CB water monitor • Complete Air Base / Port Bio Detection ACTD (FY98) • Start Joint Biological Remote/Early Warning System (JBREWS) ACTD in FY98 with fielding of ACTD systems to selected CINCs by FY01	• Demonstrate integration of chemical and biological agent detection modules into a single sensor suite • Field equipment contamination scanner, handheld • Start JBREWS objective system engineering and manufacturing development (EMD) in FY99, with production in FY02, and first unit equipped (FUE) in FY02

2.3.1.2 Potential Payoffs and Transition Opportunities. The future CB detection system will provide the capability to detect, identify, map and track all CB contamination in a theater of operations. This will enable commanders to avoid CB contamination or to assume the appropriate protection required to continue fighting and sustain their mission with minimal performance degradation and casualties. Small, lightweight chemical detectors can be incorporated into clothing ensembles to provide an individual chemical detection capability. CB detection technologies have dual use potential in monitoring air pollution, noxious fumes inside enclosed areas, and municipal water supplies.

2.3.1.3 Major Technical Challenges. The major technical challenges are in the areas of biological detection and identification, including remote/early warning sensing, improved agent discrimination and quantification, sampling efficiency, interferent rejection and genetic probe development. Size reduction of detectors, development of integrated biological and chemical detection systems, and the fusion of sensor data with mapping, imagery and other data for near real-time display of events are other areas of challenge.

2.3.2 Contamination Avoidance Modernization Strategy

The increased lethality and heightened operational tempo of the future battlefield demand responsive NBC detection and warning capabilities in order to reduce force degradation caused by contamination. These capabilities—which also encompass NBC reconnaissance, identification, warning and reporting—have the strongest urgency for force readiness and will

continue to be emphasized by the DoD community in the near and distant future. Table 2-3 shows the roadmap of DoD requirements for contamination avoidance.

Table 2-3. Contamination Avoidance Modernization Strategy

	NEAR (FY97-00)	MID (FY 01-05)	FAR (FY 06-11)
Chemical Point	• **Surface sampling capability (ICAM)** • **Automatic, digital point detection of nerve and blister agents (ACADA)** • Navy-*Ship based improved automatic point detection of nerve/mustard (IPDS)* • Navy-*Automatically detect liquid agent (SALAD)*	• **Improved, all-agent programmable automatic point detection; portable monitor, miniature detectors for aircraft interiors; interior ship spaces; individual soldiers (JCAD)** • **Detection of CB contamination in water (Agent Water Monitor)**	• **Improved surface contamination monitor** • **Low dosage miniature detector; specific identification; personal monitor**
Biological Point	• **Automatic point/mobile biodetection to detect and identify bio-agents; programmable (JBPDS)** • Navy-*Ship based Interim Biological Agent Detector (IBAD)* • Army-*Biological Integrated Detection System (BIDS)*	• **Automatic point biodetection, to detect and identify; programmable (JBPDS Block II)**	• **Automated detection of all validated biological threat agents (Joint Biological Universal Detector, JBUD)**
NBC Reconnaissance and C/B Stand-off Detection	• **Improved NBC Reconnaissance Vehicle with remote/early warning and data infusion capabilities (JSNBCRS)** • Army - *Long Range Stand-off detection and mapping of aerosol clouds (LR-BSDS)*	• **Biological remote detection and early warning capabilities (JBREWS)** • **Lightweight passive stand-off detection for chemical agent vapors (JSLSCAD)** • **Addition of biological detection and identification capabilities (JSNBCRS P3I)** • **Light reconnaissance vehicle (JSLNBCRS)**	• **Mobile stand-off detection, ranging, and mapping of chemical vapors and aerosols (JSCWILD)** • **Wide area detection**
Warning and Reporting	• **Initial automated warning and reporting interoperable with all Services, C4I (JWARN)**	• **Integrated and automatic NBC warning and reporting: mission management (JWARN P3I)**	
Radiac	• Army-*Compact, digital whole body radiation measurement (AN/UDR-13)*		• **Stand-off radiation detection and measurement** • **Portable radiation meter**

1. Joint Service programs are highlighted in **BOLD**; Service unique efforts are *italicized.*
2. Where applicable, systems which meet requirements are listed following the entry.

Early detection and warning is the key to avoiding NBC contamination. As a result, DoD is concentrating RDA efforts on providing its warfighters real-time capabilities to detect, identify, quantify, and warn against all CB warfare threats below threshold effects levels. Real time detection of biological agents "below threshold effects levels" is unlikely; microbial pathogens that can produce productive infections with 1–10 organisms are likely to create effective exposures at the same time the detector "sees" it. Current emphasis is on multi-agent sensors for biological agent detection and early warning detection of chemical and biological agents. To meet the needs of the next three to five years, several stand-alone detectors and

sensors are being developed. As detection technology matures, development efforts will focus on system miniaturization, improved sensitivity and range, and decreased false alarm rate. This focus will facilitate the integration of chemical detectors into personal warfighter gear, chemical and biological detectors onto various air, sea, and ground platforms, and integration of detectors into automated warning and reporting networks. Table 2-4 provides an overview of RDA efforts and Service involvement.

Table 2-4. Contamination Avoidance RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Automatic Detectors and Monitors	- XM22 Automatic Chem Agent Detector (ACADA)	RDTE	Joint	Joint	Joint	Interest
	- Shipboard Liquid Agent Detector (SALAD)	RDTE				Rqmt
	- Improved Point Detection System (IPDS)	Production				Rqmt
	- Improved CAM (ICAM)	Production	Rqmt	Interest	Rqmt	Interest
	- Joint Service Agent Water Monitor (JSAWM)	RDTE	Joint*	Joint*	Joint*	Interest
	- Joint Chemical Agent Detector (JCAD)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Biological Point Detection					
	--Interim Biological Agent Detector (IBAD)	Production				*Rqmt*
	--Biological Integrated Detection System (BIDS NDI)	Fielded	*Rqmt*	*Rqmt*		
	--BIDS P3I	RDTE	*Rqmt*			
	- Joint Bio Point Detection System (JBPDS)	RDTE	Joint	Joint	Joint	Joint
Remote/ Early Warning	- Joint Service Lightweight Stand-off Chemical Agent Detector (JSLSCAD)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Joint Service Chemical Warning and Identification LIDAR Detector (JSCWILD)	RDTE	*Rqmt*	*Rqmt*		
	- Biological Stand-off					
	--Joint Remote Biological Early Warning System (JBREWS)	RDTE	Interest	Interest	Interest	Interest
	--Long Range Bio Stand-off Detection System-NDI (LRBSDS-NDI)	Production	*Rqmt*	*Interest*		*Interest*
	--LRBSDS	RDTE	*Rqmt*	*Interest*		*Interest*
NBC Recon	- Joint Service NBC Reconnaissance System (JSNBCRS)	RDTE				
	--M93A1 NBCRS/CB Mass spectrometer (See BIDS)	*	*Rqmt*		*Rqmt*	
	--Joint Service Light NBCRS/Lightweight Recon System (LNBCRS)	*	Joint*	Joint*	Joint*	*Interest*
Warning and Reporting	- Joint Warning and Reporting Network (JWARN)	RDTE	Joint*	Interest*	Joint*	Joint*
	-- Multipurpose Integrated Chemical Agent Detector (MICAD)	*	*Rqmt*	*Interest*	*Rqmt*	
Radiacs	- AN/UDR-13 Pocket Radiac	Production	Joint	Interest	Joint	

Joint= Joint Service requirement
Rqmt= Service requirement
Rqmt, Interest= sub-product requirement or interest
Joint*=Draft Joint Service requirement
int-NIR= Service interest, no imminent requirement
*= Sub-product(s) of a Joint project

The management challenge involves the coordination and consolidation of dozens of detection and warning RDA efforts across the Services. This strategy, led by the JSMG through the Contamination Avoidance Commodity Area Manager (formerly the Joint Service Detection Working Group), resulted in the initiation of RDA efforts which shared common technical goals, but were constrained to Service unique requirements. Recent management organizations and initiatives, such as the Joint Program Office for Biological Defense (JPO-BD) and the Joint NBC Defense Board are building Joint Service coordination across the mission area.

Over the past four years, JPO-BD has managed several single service and joint biological detection programs. Three single service biodetection programs fielded in the past year, in which JPO-BD has managed include:

- the Navy's Interim Biological Agent Detector (IBAD); 25 detectors are being fielded throughout FY96–97,
- the Army's Biological Integrated Detection System - Non-Developmental Item (BIDS NDI), which has been type classified standard, and fielded to the newly activated (5 Oct 96) 310th Chemical Company,
- and the Army's Long Range Biological Standoff Detection System (LR-BSDS), which has also been type classified standard, and is also being fielded this year to the 310th Chemical Company (3 systems).

Key joint systems JPO-BD manages include:

- The Joint Biological Point Detection System (JBPDS) which enters Engineering and Manufacturing Development (EMD) phase in FY97. The JBPDS will be the first truly joint biological detection acquisition program that is built on an approved Joint Operational Requirements Document (JORD).
- The Air Base/Port Bio Detection Advanced Concept Technology Demonstration (ACTD) which has undergone two major field trials, completed drafting of a Concept of Operations (CONOPS), and will begin limited fielding in FY97.
- The Joint Biological Remote/Early Warning System (JBREWS) ACTD which starts development in FY98. The JBREWS ACTD is also supported by the Counterproliferation Support Program.

Over the past three years, the JSMG and JSIG, through the Contamination Avoidance Commodity Area Manager, with assistance from JPO-BD transformed and consolidated 44 separate contamination avoidance developmental efforts into ten fully coordinated joint projects. Requirements, nomenclature, and program plans for these projects are maturing and will be complete by FY98. The requirements for the Joint Biological Point Detection System were developed by a Joint Service working group, and responsibilities for project execution have been clearly defined by the four Services to maximize their research and development effectiveness and to avoid duplication of effort. The Joint Programs are:

- Automatic Chemical Agent Detector Alarm (ACADA)
- Joint Chemical Agent Detector (JCAD)
- Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)
- Joint Service Chemical Warning and Identification LIDAR Detector (JSCWILD)
- Joint Biological Point Detection System (JBPDS)
- Joint Biological Remote Early Warning System (JBREWS)
- Joint Service NBC Reconnaissance System (JNBCRS)
- Joint Warning and Reporting Network (JWARN)
- Joint Service Agent Water Monitor (JSAWM)

2.3.3 Joint Service Contamination Avoidance Programs

Completing the consolidation of Joint Service contamination avoidance programs has been a primary goal for the past two years. Building upon the success of the prior year, all

detection programs have been restructured to meet current multi-Service needs. Bolded entries in Table 2-3 highlight Joint programs. Detailed descriptions of Joint contamination avoidance programs are at Annex A.

Chemical Warfare Agent Contamination Avoidance

A non-developmental item NDI Automatic Chemical Agent Detector (ACADA) is being purchased for point detection of low level chemical agent vapors. ACADA is suitable for many vehicle-mounted and man-portable applications. The Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) for passive standoff, on-the-move detection of chemical agent vapor is in Phase II (Engineering and Manufacturing Development, EMD) of the acquisition cycle. The core system of JSLSCAD will weigh approximately 13 pounds and occupy approximately 1.3 cubic feet. The system may be modified to accommodate a variety of requirements. To date, a 360° x 60° scanner was developed for Armored Systems Modernization applications (tracked and wheeled vehicles), and the system was integrated into a gimbal for Marine Corps helicopters and unmanned aerial vehicle (UAV) contamination avoidance roles. This system is also being considered by the Navy for shipboard use and by the Air Force for use at air bases.

In the near-term, the four Services are focusing chemical point detection requirements on the Joint Chemical Agent Detector (JCAD), formerly known as the Joint Service Chemical Miniature Agent Detector (JSCMAD). The JCAD will represent a chemical point detection system in order to accomplish a variety of mission requirements on multiple service platforms. This system will be considerably smaller and lighter than the ACADA and can be configured for a variety of applications such as individual soldier detectors, shipboard chemical agent monitoring, special operations forces (SOF) applications, and aircraft interior detection. The JSMG selected the Air Force as lead service for the JCAD. The Army, Air Force, and Marine Corps have also agreed to focus upon the development of a Joint Service Light NBC Reconnaissance System (LNBCRS). The proposed system will consist of a suite of detectors required for a specific mission which could be easily integrated into the platform of choice. Currently two configurations are proposed: a light and a medium version, to fulfill expeditionary and armored mission profiles, respectively. The FOX NBCRS would fulfill heavy requirements. The FOX NBCRS is being upgraded to include a chemical stand-off detection capability and other electronic improvements including data fusion.

In the mid- to far-term, the Army and Air Force have agreed to a Joint Service Chemical Warning and Identification LIDAR Detector (JSCWILD). The JSCWILD is a laser-based standoff detection system being developed to meet the requirements for the detection of chemical liquids, aerosols and vapors. Although this system is much heavier than its passive counterpart (JSLSCAD), it does provide the ability to detect chemical agents in all forms (liquids, vapors, aerosols) as well as mapping and ranging information. The Air Force's primary use for this system will be air base defense. A requirement for an agent water monitor has been identified by the Army, Air Force, and Marines. Joint program plans are being developed.

Biological Warfare Agent Contamination Avoidance

Currently, there are six detection efforts being conducted under the Joint Program Office for Biological Defense (JPO-BD): (a) the Interim Biological Agent Detector (IBAD); (b) the Joint Biological Point Detection System (JBPDS); (c) the Biological Integrated Detection System (BIDS); (d) the Long Range Biological Stand-off Detection System (LR-BSDS); (e) the Air Base/Port Biological Detection Advanced Concept Technology Demonstration (ACTD); and (f) the Joint Biological Remote/Early Warning System (JBREWS) ACTD.

In the near-term, the Joint Bio Point Detection System (JBPDS) will meet each of the four Services' needs for a biological point detector. This system will be integrated on Service designated platforms. IBAD is the Navy's shipboard detection system, while the BIDS is the Army's land based system. The LR-BSDS is a helicopter mounted infrared LIDAR system for the detection, ranging and tracking of aerosol clouds that may indicate a biological warfare (BW) attack. The Air Base/Port Biological Detection ACTD will develop and demonstrate for the first time the capability to protect high value fixed sites against biological warfare attacks.

In the mid-term, the JPO-BD will develop the Joint Biological Remote Early Warning System to gain advanced warning of biological warfare attacks.

JPO-BD's concept for the ultimate, joint service biological detector is the Joint Biological Universal Detector (JBUD). JBUD is envisioned to be a miniaturized, multi-technology, automatic system that may be manned or unmanned, capable of detecting all BW agents, and able to automatically warn troops and report pertinent data relative to a BW attack.

2.3.4 Warning and Reporting

Warning and reporting is a critical issue in contamination avoidance. The Services have agreed to expedite development of this capability by integrating ongoing hardware (MICAD) and software (HAZWARN and ANBACIS) into a Joint Warning and Reporting Network (JWARN). This network will be compatible with, but not duplicate, all C^4I equipment both current and developmental. Initial urgent requirements of software will be fielded. In FY99 a Warning and Reporting Network of hardware and software will be fielded. The system will then be continuously improved to provide increased management and control functions, as well as to integrate features of the emerging Global Command Control System (GCCS).

2.3.5 Other Contamination Avoidance Programs

Various detection and warning requirements have unique mission profiles and technical specifications. While in some instances the development effort may leverage off the technical achievements of a closely related detection and warning project, the application beyond its intended mission is limited and accordingly supports a specific requirement. Starting in first quarter FY97, the Navy is producing the Improved (chemical agent) Point Detection System (IPDS), an upgrade for the existing shipboard Chemical Agent Point Detection System (CAPDS). IPDS, which offers continuous operation and advanced detection sensitivities that do

not respond to shipboard interferents, is not adversely affected by the high electromagnetic environment around ships. IPDS improves detection thresholds, response time, and adds the capability to detect mustard agents. The Navy is also developing the Shipboard Automatic Liquid Agent Detector (SALAD). This shipboard system will be used to automatically detect and alarm in the presence of liquid chemical agents. By detecting automatically, it will minimize the sailor's exposure to contamination. As with the IPDS, it will offer continuous operation and advanced detection sensitivities that do not respond to shipboard interferents and are not affected by naval electromagnetic interference (EMI).

Defense Advanced Research Projects Agency (DARPA) Programs

As one of the major programs conducted under its Defense Science Office, DARPA is pursuing the demonstration and development of biological warfare (BW) defense capabilities. The DARPA BW defense program is developing advanced point detectors for BW agents and extending the combat informatics program to BW defense. The DARPA program is developing detectors with minimal or no false alarms and small size (on an electronic chip) that can be operated unattended. The BW Defense informatics thrust is developing the capability to deliver information to the field medic about BW treatment protocols and to provide BW casualty information to the medical and field commands. In addition, DARPA conducted efforts beginning in FY96, to develop medical BW countermeasures with an emphasis on multi-agent approaches. FY96 efforts included projects demonstrating the feasibility of using modified red blood cells to eliminate pathogens from the blood, and preliminary exploration of approaches for using stem cells as a vehicle for therapeutic use.

2.4 PROTECTION

When early warning is not possible or units are forced to occupy or traverse contaminated environments, protection provides life sustainment and continued operational capability in the NBC environment. The two types of non-medical protection are individual and collective.

- ***Individual protective equipment*** (IPE) includes protective masks and clothing. Protective masks that reduce respiratory stress on the user while improving compatibility with weapon sighting systems and reduce weight and cost are being developed. Technology advances are being pursued to produce mask systems that provide fully compatible vision capabilities, laser/ballistic protection, and further reduction in logistics burden. Protective clothing is being developed which will present less weight and heat stress burden than present equipment.

- ***Collective protection equipment*** includes shelters for command posts, medical facilities, rest and relief shelters/buildings, vehicular collective protection, and safe zones aboard ships. Lightweight shelters with integrated environmental control and power generation capabilities are being developed. Technology improvements are being pursued to reduce weight and size and improve deployability. Technology improvements that reduce

logistic and manpower requirements; *e.g.*, filter change frequency and shelter assembly and disassembly time are also being pursued.

2.4.1 Protection Science and Technology Efforts

2.4.1.1 Goals and Timeframes. The goals of the protection subarea are to maintain a high level of protection against CB warfare agents and radiological particles while reducing the physiological burden associated with wearing protective equipment; to integrate CB protection with protection from environmental, ballistic and other threats; and to provide a protective environment for personnel to complete their mission while operating in aircraft, armored vehicles, ships, shelters and other large-area enclosures (see Table 2-5). To achieve these goals, physiological performance requirements key to the design and evaluation of clothing and respirators are being established. New barrier and filtration materials, and permeable fabrics to accommodate these performance requirements, are being developed and evaluated. Regenerative filtration materials and techniques that would virtually eliminate the need to replace collective protection filters are being explored.

Table 2-5. Protection Science and Technology Strategy

By 1997	By 2002	By 2007
• Prototype mask with 50% reduced breathing resistance and 50% improved field of vision • Demo Joint Service Lightweight Suit Technology (JSLIST Component)	• Demonstrate regenerative filter prototype • Demonstrate advanced adsorbents to enhance or replace carbon • New chemical protective clothing, gloves and footware materials transition to the Force XXI Land Warrior • Personal air conditioner backpack weighing less than 10 pounds	• Continuous operations filter technology • Lightweight materials available

2.4.1.2 Potential Payoffs and Transition Opportunities. Individual protection investments will result in improved respiratory and percutaneous (skin) protection with reduced physiological and psychological burden to the individual soldier. Improved air purification systems for collective protection applications will allow for extended operations enclosures in a CB contaminated environment and reduce the logistics burden associated with filter replacement. Filtration technology has commercial application to the chemical industry and for automotive applications.

2.4.1.3 Major Technical Challenges. Integrating CB protection into future warrior systems necessitates tradeoffs between performance requirements and limitations of materials and designs. Integral respiratory protection requires tradeoffs between physiological performance parameters such as pulmonary function, field of view, speech intelligibility and anthropometric sizing against cost, size/weight, protection time, and interfacing with other equipment. Integral CB protective clothing requires tradeoffs between minimizing thermal stress and moisture buildup against agent resistance, weight/bulk and power requirements of cooling systems. Air purification systems require tradeoffs with respect to size, weight and power requirements, as well as longer life and minimal environmental impact.

2.4.2 Protection Modernization Strategy

Forces cannot always avoid NBC hazards, therefore individual warfighting units must be provided materiel to protect them from the effects of these lethal agents. Protection must be effective against all known threats and not measurably degrade the performance of personnel, weapons, or equipment. Total NBC protective measures, which consist of individual and collective protection, allow our forces to maintain combat superiority in a contaminated environment. A summary of protection modernization requirements is provided in Table 2-6.

The goal of the protection RDA area is to provide equipment which allows US forces to operate in a contaminated NBC environment with minimal degradation of the warfighters' performance. The near-, mid-, and far-term project efforts are aimed at maintaining current protection levels while reducing physiological and logistical burdens. Table 2-7 provides an overview of individual and collective protection RDA efforts and Service involvement.

Individual protection equipment (IPE) consists of eye/respiratory and percutaneous protection: a mask with hood and protective garments, boots, and gloves. The IPE issued to US forces protects against all threat chemical and biological agents. Its chemical defense capabilities are routinely demonstrated with actual chemical agents in the Chemical Defense Training Facility (CDTF), U.S. Army Chemical School, Ft. McClellan, Alabama.

Protective masks will be improved to provide greater user comfort and to reduce the breathing resistance currently encountered. Mask systems will require increased NBC survivability and compatibility with combat or personal equipment. Future respiratory systems, such as the A/P23P-14(V)N , the M45, and the far-term Joint Service Aviator Mask (JSAM) and Joint Service General Purpose Mask (JSGPM) will require enhanced compatibility with both life support and tactical systems on fixed and rotary wing aircraft. In the future, the focus will be on integrated respiratory protective ensembles which offer optimal compatibility with personal, tactical and crew support systems.

Table 2-6. Protection Modernization Strategy

	NEAR (FY97-00)	MID (FY01-05)	FAR (FY06-11)
Individual Eye/ Respiratory	• **Voice amplification; laser/ballistic eye protection; improved decontamin-ability, better comfort (M40A1/M42A1)** • Army -*Aircrew mask compatible with sighting systems and night vision goggles (M48/49)* • Army -*Improved compatibility with aviation sighting/night vision systems; protection against future threats agents (M45)*	• **Reduced physiological burden, improved comfort, enhanced optical and communications cooling** • Navy -*Improved complete protection for all aircrews (A/P 23P-14(V)N)*	• **Advanced Integrated Individual Soldier Protection system (Future Soldier System)** • **Improved multiple agent protection**
Individual Clothing	• **Advanced protective suit technology; lighter, improved agent and flame protection; reduced heat stress integrated with all respiratory and micro-climatic cooling systems (JSLIST)** **- Improved foot protection (MULO)** **- Improved hand protection (Improved CB Glove)** • Army -*Improved protection with self contained breathing capability for special purposes (STEPO-I)*	• **Improved protection, less burdensome protective suits; improved foot and hand protection/less burdensome (JSLIST)**	• **Integrated multiple threat modular protection (chemical, biological, environmental, ballistic direct energy and flame)** • **Improved protection, less burdensome protective suits; improved foot and hand protection/less burdensome (JSLIST P3I)**
Collective Systems	• **Improved filters to extend filter life, reduce maintenance and reduce logistical burden** • Navy - *Backfit ships with contamination free protected zones - (Selected Area Collective Protection System SACPS)* Marine Corps -*Protection for all combat vehicles and unit shelters* • Army -*NBC protection for tactical Medical units - CB Protective Shelter (CBPS)*	• **Regenerable protective filtration for vehicles/vans; reduces logistics burden, size, weight, power needs protects against future threat agents** • Army -*Modular, reduced size, weight and power for vehicle/ shelter collective protection - Advanced Integrated Collective Protection Shelter (AICPS)*	• **Family of advanced lightweight protective filtration systems for vehicles, shelters, ships, light forces**

1. Joint Service programs are highlighted in **BOLD**, Service unique efforts are *italicized.*
2. Where applicable, systems which meet requirements are listed following the entry.

Table 2-7. Protection RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
	INDIVIDUAL PROTECTION:					
Integrated	- Force XXI Land Warrior	RDTE	Rqmt	Interest	Interest	Interest
Eye/ Respiratory Protective Masks	- MBU-19/P Aircrew Eye/respiratory Protection (AERP)	Production	Interest	Fielded	Interest	
	- M48/49 Aircraft Mask	RDTE	Rqmt			
	- CB Respiratory System (A/P 23P-14(V)N)	RDTE			Rqmt	
	- M45 Aircrew Protective Mask (ACPM)	RDTE	Rqmt		Interest	
	- M40A1/M42A1	Production	Rqmt		Rqmt	
	- MCU-2A/P	Production		Fielded		Rqmt
Ancillary Equipment	- Protection Assessment Test System (PATS)	Production	Rqmt	Fielding	Fielded	Interest
	- Voice Communication Adapter	Production	Rqmt	Rqmt	Fielded	Fielded
Battlefield Protective Suits	- CB Protective Overgarment Saratoga	Fielded	Interest		Fielded	Interest
	- Chemical Protective Undergarment (CPU)	Fielded	Rqmt		Int-NIR	
	- Aircrew Uniform Integrated Battlefield (AUIB)	Production	Rqmt	Fielded	Int-NIR	
	- Joint Service Lightweight Integrated Suit Technology (JSLIST)	RDTE				
	-- Overgarment	*	Rqmt	Rqmt	Rqmt	Rqmt
	-- Undergarment	*	Rqmt	Interest	Interest	
	-- Duty Uniform	*	Rqmt	Rqmt	Rqmt	
	-- Boots		Rqmt	Rqmt	Rqmt	
	-- Gloves	*	Rqmt	Rqmt	Rqmt	
Specialty Suits	-Suit Toxicological Environmental Protective Outfit (STEPO-I)	Production	Rqmt			
	- EOD Ensemble	Production	Rqmt			
	- Improved Toxicological Agent Protective (ITAP)	RDTE	Rqmt	Rqmt	Interest	Interest
	COLLECTIVE PROTECTION					
Collective Protection Equipment	- M20A1/M28 Simplified CPE	Fielded	Rqmt			
	-Modular CPE (GPFU)	Fielded	Rqmt	Interest		Interest
	- CB Protected shelter (CBPS) (Medical)	Production	Rqmt		Interest	*
	- Advance Integrated Collective Protective System (AICPS) for Vehicle, Vans, and Shelters	RDTE	Rqmt		Interest	
	- Selected Area Collective Protection System (SACPS)	Production				Rqmt
	Shipboard Collective Protection Systems					
	- Shipboard Collective Protection System (CPS)	Production	Interest	Interest		Rqmt
	- Improved Shipboard CPS	RDTE				Rqmt

Rqmt = Product requirement
Interest = Product Interest
Int-NIR = Product Interest, No Imminent Requirement

* - Sub-Product(s) of a Consolidated Joint Service Project
Rqmt, Interest = Sub-Product requirement or Interest

Future protective clothing ensembles will be required for land, sea, air, and marine forces to achieve reductions in bulk and weight without any loss of protection or durability. To satisfy these needs, the four Services have consolidated their mission specific requirements into a first truly joint evaluation program for the next generation chemical garments--the Joint Service Lightweight Integrated Suit Technology (JSLIST) program. New accessories, such as gloves and footwear, are also required to execute missions and tasks which require greater tactility and traction. Similarly, clothing systems for Explosive Ordnance Disposal (EOD) personnel are required to enhance existing chemical protection systems without undue physiological burdens.

Collective protection equipment (CPE) development efforts are focused on NBC protection systems at the crew, unit, and platform level. New CPE systems will be smaller, lighter, less costly and more easily supported logistically. New systems are required to make "clean" environments more available for critical operations (*i.e.*, where IPE otherwise places an unacceptable burden upon the Service member in performing duties) and for essential rest and relief. Modernization concentrates on: (1) improved air filtration and environmental control methodologies and integration, (2) advanced technologies integrated into power and ventilation for systems that offer a significant improvement in logistics, (3) applications on essential vehicles, vans and shelters, and (4) improvements to current vapor and particulate filtration media to extend filter life. Efforts are in place to support major weapons systems developments such as the V-22 Osprey, the Comanche, and Armored Vehicles.

2.4.3 Joint Service Protection Programs

Joint programs are shown in Table 2-6 as bolded entries. A detailed description of Joint IPE and CPE programs is at Annex B.

Individual Protection

Eye/Respiratory. The M40 and M42 masks (for individuals and armored vehicle crewmen, respectively) are undergoing the final stages of fielding to replace their M17 and M25 series counterparts. The new masks offer increased protection, improved fit and comfort, ease of filter change, better compatibility with weapon sights, and a second skin which is compatible with Army and Marine Corps protective ensembles. The second skin design also is being reviewed by the Navy and Air Force for potential adoption. The Army, Marines, and Air Force are also fielding the Protection Assessment Test Systems (PATS) to provide users of the M40, M42, and MCU-2/P masks with a rapid and simple means for validating the fit and function of the mask to ensure readiness. The Navy is evaluating using PATS with its MCU-2/P series mask.

The Navy, in coordination with the Marine Corps, is leading an effort to equip all forward deployed fixed and rotary wing aircrew with improved chemical, biological, and radiological (CBR) protection. The CBR ensembles will feature off-the-shelf items, such as the A/P23P-14(V)N respirator assembly. The Army, in cooperation with the Marine Corps, recently completed a product improvement program for the M40 series mask. The Air Force continues to field Aircrew Eye-Respiratory Protection (AERP) systems to protect aircrews from CB hazards. This system complements the recently fielded lighter weight aircrew ensemble.

Mid- and far-term, research is focused on improved vapor and particulate filtration technology, as well as improved masks for light and special operations forces (SOF). Far-term plans include the Joint Service Aviation Mask and Joint Service General Purpose Mask, which will provide improved eye, respiratory, and face protection against current and future agents. It will maximize compatibility with future weapon systems, be lightweight, and offer modular facepieces to accommodate a variety of mission profiles.

Clothing. In the area of full body protection, the JSLIST program is underway to coordinate the selection of advanced technology chemical protective materials and prototype ensembles. The program originated as a US Marine Corps 6.2 and 6.3 demonstration of chemical protective materials and garment designs. In August 1992, the Service Project Managers for chemical protective clothing agreed to combine their programs, using the initial Marine Corps data base and other R&D efforts. Requirements for chemical protection, durability, heat stress reduction, launderability, concept of use and flame protection vary by Service and mission.

Clothing systems will utilize new material technologies from domestic and foreign sources. There will be one overgarment design, one primary garment design, and one undergarment design. The scheme will minimize the number of suits and maximize inter-Service compatibility. Merging development efforts will eliminate unnecessary duplications and allow each Service to leverage those technologies which offer the best merit and performance. Materials which meet Services' requirements will be placed on a qualified materials list to encourage multi-source competition and to provide surge capability. Variations in suit design will be minimized to gain economies of scale in production and help maintain a vital industrial base.

The Army, in coordination with the other Services, and as a part of JSLIST, is conducting a development project for a Multipurpose Overboot to replace the current black vinyl overboot with a boot that has greater durability, better traction on all surfaces and improved protection. A similar effort is underway for an Improved CB Protective glove which will have better tactility and protection. Both project schedules are being executed in parallel with the JSLIST program.

In the mid-term, the Army in coordination with the other three Services, is developing an Improved Toxicological Agent Protective (ITAP) ensemble for EOD and depot operations in Immediate Danger to Life and Health (IDLH) contamination concentrations. The ITAP ensemble will incorporate improvements in material and design. It includes a one-hour supplied air bottle system, which can be switched to a filtered air respirator when operators exit the area of high contamination. A Personal Ice Cooling System (PICS) is being developed for use with the ITAP. The ITAP ensemble and PICS will be Joint Service programs. In addition, the Army is working with the Air Force on a chemical protective firefighter's ensemble leveraging the technology from the JSLIST program. Detailed system requirements and program plans are currently being coordinated among the Services.

In the far-term, efforts will focus on integrated protection for the Force XXI Land Warrior System. This next generation technology will be directed toward integrating CB protection into a system which will also provide environmental, ballistic, directed energy and flame protection, as well as reduced physiological burden. A strong emphasis on supporting technologies must continue. Materials that detoxify a broad range of chemical and biological agents on contact, which can be incorporated into fibers, fabrics and semi-permeable membranes are being developed using biotechnology as well as more conventional approaches.

Collective Protection

The Army has fielded the M20A1/M28 Simplified CPE to provide CP protection and environmental control to existing structures. The new simplified CPE provides liquid agent resistance and allows expansion of protected area.

The Chemical/Biological Protective Shelter (CBPS) is going into production to provide clean areas in mobile field hospitals.

Near-term collective protection efforts, such as the Advanced Integrated Collective Protection System (AICPS) will provide a compact, integrated package for power, filtration, and environmental control (heating/cooling). The AICPS will provide transportability and maintainability enhancements and decrease system set-up times. The Navy Improved Collective Protective System (ICPS) effort will increase the shipboard filter life (from the current one or two years) to at least a three year service life, through the use of new pre-filter materials and the use of a new HEPA filter media. The ICPS will provide millions of dollars of savings in life cycle costs.

2.4.4 Other Protection Programs

Program supporting requirements of a single service are shown in table 2-6 as italicized entries. A detailed description of IPE and CPE projects is presented in Annex B.

Individual Protection

Eye/Respiratory. The Army is developing the M48/49 protective masks to replace the M43 series masks. The M48 will be for Apache pilots and the M49 for general aviator use. They will be lighter and offer enhanced protection and compatibility with night vision and aircrew system.

In the near-term, the Army will replace the M43 mask for the general aviator with the Aircrew Protective Mask, M45. The M45 will be lighter and less expensive than the M43 and feature CB protection without the aid of force ventilated air.

Clothing. The Aircrew Uniform Integrated Battlefield (AUIB) and the Chemical Protective Undergarment (CPU) are approved for procurement. The AUIB is a flame resistant CB protective uniform which is lighter and less bulky than previous ensemble configurations. The CPU, which has been adopted by armor crews, is worn under the Nomex coverall.

The Army has also completed fielding the Interim-Self-Contained Toxic Environment Protective Outfit (STEPO-I). The STEPO-I was introduced for limited EOD and depot operations in contamination concentrations which are of Immediate Danger to Life and Health (IDLH).

Collective Protection

The Navy now includes the Collective Protection System (CPS) on all new construction ships. Currently the DDG-51, LHD-1, AOE-6 and LSD-41 ship classes are being built with CPS. The Navy also has the capability to backfit CPS on ships already in Service. The Selected Area Collective Protective Systems (SACPS) has been installed on selected LHA-1 class ships. Air inside the zone is maintained at a higher pressure than the outside air to prevent leakage of contaminants into the protected zone. In the mid-term, the Navy is designing the V-22 Osprey to be the first Naval aircraft to incorporate CBR protection for both aircrew and passengers. The ability to provide a pressurized, contamination free environment is a design requirement.

2.5 DECONTAMINATION

When contamination cannot be avoided, personnel and equipment must be decontaminated to reduce or eliminate hazards after NBC weapons employment. Decontamination systems provide a force regeneration capability for units that become contaminated. Modular decontamination systems are being developed to provide decontamination units with the capability to tailor their equipment to specific missions. Technology advances in sorbents, coatings, catalysis, and physical removal will reduce logistics burden, manpower requirements and lost operational capability associated with decontamination operations. The following sections detail CB decontamination science and technology efforts, modernization strategy, and Joint Service programs.

2.5.1 Decontamination Science and Technology Efforts

2.5.1.1 Goals and Timeframes. The goal of decontamination research and development is to develop technologies that will eliminate toxic materials without performance degradation to the contaminated object and be environmentally safe (see Table 2-8). This area includes decontamination of personnel, individual equipment, tactical combat vehicles, aircraft, facilities, and fixed sites. Decontamination technologies currently being pursued include enzymes, catalysts that improve reactivity, decontaminants that are effective in both fresh and brackish water, and improved reactive sorbents. Contamination control involves investigating procedures that minimize the extent of contamination pickup and transfer, and maximize the ability to eliminate the contamination pickup on-the-move as well as during decontamination operations.

Table 2-8. Decontamination Science and Technology Strategy

By 1997	By 2002	By 2007
• Demo improved sorbents • Aircraft Interior Decon procedures (non-system)	• Sensitive Equipment Decon Systems • Demonstrate enzymatic decon • Improved decon material to replace DS 2	• Demonstrate environmentally safe, sensitive equipment and decon materials • New self-decontaminating materials

2.5.1.2 Potential Payoffs and Transition Opportunities. The payoff from enhanced decontaminants and decontamination systems will be new non-corrosive, non-toxic, non-flammable, and environmentally safe decontamination systems suitable for a timely elimination of CB agents from all materials and surfaces. This ability will allow the forces to reconstitute personnel and equipment more quickly to increase combat efficiency and lessen the logistic burdens. In the future, reactive coatings may allow the continuation of combat operations without the need to disengage for decontamination. Dual use potential for environmental remediation, especially those dealing with pesticide contamination, is being exploited.

2.5.1.3 Major Technical Challenges. There are two principle technical difficulties associated with this effort. The first is the development of decontaminants which are reactive, non-aqueous, non-corrosive, safe to use on sensitive equipment, decontaminate a broad spectrum of chemical and biological agents, and environmentally safe. The second technical difficulty is the development of decontamination systems that effectively clean all surfaces and materials, while at the same time reduce the manpower and logistics burden. Also, new concepts or technologies for decontamination of large areas are needed.

2.5.2 Decontamination Modernization Strategy

Decontamination systems provide a force regeneration capability for units that become contaminated. Existing capabilities rely upon the physical application and rinse down of decontaminants on contaminated surfaces. Existing systems are effective against a wide variety of threat agents, yet are slow and labor intensive, and present logistical, environmental, and safety burdens. To improve capabilities in this functional area, the Joint Services place emphasis upon new decontaminating technologies which reduce existing manpower and logistics requirements. They are safer on the environment, the warfighter, and equipment. Table 2-9 shows the roadmap for modernizing decontamination systems in DoD.

The goal of the NBC decontamination program area is to provide technology which removes and detoxifies contaminated material without damaging combat equipment, personnel, or the environment. Research and development of non-corrosive, all-agent multipurpose decontaminants and decontaminating systems for combat equipment, aircraft, personal gear, and skin remains a priority. Alternative technologies, such as sensitive equipment decontamination methods and large scale automated decontamination systems attract interest across the four Services. Table 2-10 provides an overview of Joint Service RDA efforts and Service involvement.

Table 2-9. Decontamination Modernization Strategy

	NEAR (FY97-00)	MID (FY01-05)	FAR (FY06-11)
Skin and Equipment Decontam-inants	• **Less caustic and damaging to equipment (M291/M295)**	• **Non-caustic, non-corrosive decontaminant for personnel and equipment** • Army-*Higher efficiency decon methods (Sorbent Decon)*	
Bulk Decontam-inants	• **Non-caustic, non-corrosive easy to store multipurpose decontaminants**	• **Decontaminants for fixed facilities** • Army -*Environmentally acceptable replacement for DS-2* • Army -*Enzymes for chemical agent decontamination* • Navy -*Less caustic capability*	• Navy -*Contamination resistant shipboard materials*
Expedient Delivery Systems		• **Auto-releasing coatings; reduces skin contact hazard & labor requirements**	• **Self-decontaminating auto releasing coatings; reduces man-power and logistic requirements eliminates skin, contact hazard** • Army -*Advanced non-aqueous self-strip coating to reduce water and labor requirements*
Deliberate Delivery Systems	• **High pressure water wash; mechanical scrubber; improved decontaminate dispenser (increased vehicle throughput)** • Army -*High pressure hot water washing and decontaminate scrubber capability; reduced water, labor, and logistic burden (M21/M22 Modular Decon System)*	• **Non-aqueous capability for electronics, avionics and other sensitive equipment** • Air Force - *Sensitive equipment decontaminants for aircraft interiors*	• **Rapid large scale automated decon capability for fixed sites; reduced manpower and logistic burden** • **Vehicle interior decon capability** • Army -*Waterless decon capability for electronics and avionics*

1. Joint Service programs are highlighted in **BOLD** while Service unique are *italicized.*
2. Where applicable, systems which meet requirements are listed following the entry.

Table 2-10 Decontamination RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Personnel	- M295 Individual Equipment Decontaminating Kit	Production	Fielded	Interest	Fielded	Interest
	- M291 Skin Decontaminating Kit	Production				
Combat Equipment, Vehicles, and Aircraft	- M17A2/A3 Lightweight Decontamination System	Production	Fielded	Interest	Fielded	Interest
	- M21/M22 Modular Decontamination System (MDS)	RDTE	Rqmt	Int-NIR	Int-NIR	Int-NIR
	- M17 Diesel Lightweight Decontamination System	RDTE		Int-NIR	Rqmt	Interest
	- Sensitive Equipment Decon	RDTE	Rqmt	Interest	Interest	Interest
Decontaminant Solutions and Coatings	- Sorbent Decontamination System	RDTE	Rqmt	Interest	Rqmt	Interest

Rqmt = Product Requirement
Interest = Product Interest
Int-NIR = Product Interest, No Imminent Requirement
* = sub-Product(s) of a Consolidated Joint Service Project
Rqmt, Interest = Sub-Product Requirement or Interest

2.5.3 Joint Service Decontamination Programs

The Army has developed the M291 skin decontamination kit as a replacement to the M258A1 decontamination kit for all Services, and is currently introducing the M295 for improved personal equipment decontamination. The M295 provides the warfighter a fast and non-caustic decontamination system for personal gear. The Army and Marine Corps will be the first Services to field the M295.

In the near- and mid- term, DoD continues to research new multi-purpose decontaminants as a replacement for bulk caustic Decontamination Solution 2 (DS2) and corrosive Super Tropical Bleach (STB). New technologies, such as sorbents, enzymatic foams, and reactive decontaminating systems are being explored and may offer operational, logistics, cost, safety, and environmental advantages over current decontaminants. It should be noted that present shipboard chlorine-based decontaminant solutions pose an unacceptable corrosion risk to Naval aircraft. Current procedures require the use of fresh water and normal aircraft detergent solutions.

In the far-term, the Services are seeking non-aqueous decontamination systems to provide for sensitive equipment decontamination at mobile and fixed sites. Additionally, there is interest and research in self-stripping coatings which can reduce or eliminate the necessity of manual decontamination. A detailed description of the decontamination projects is presented in Annex C.

2.5.4 Other Decontamination Programs

In the near- and mid-term, the Army is developing the Modular Decontamination Systems (MDS) to enhance vehicle and crew weapon decontamination. The MDS will support deliberate decontamination for ground forces and possess mechanical scrubbing and improved decontaminant dispensing capabilities. It will also offer a reduction in size, weight, logistics burden, and workload requirements over existing decontamination systems. Similarly, the

Marine Corps is exploring alternative man-portable decontamination systems and is assessing the feasibility of converting the gasoline powered M17 Lightweight Decontamination System (LDS) with a lightweight diesel engine.

2.6 NON-MEDICAL CB DEFENSE REQUIREMENTS ASSESSMENT

➢ **Advanced technologies and new methods are currently being examined for fixed facility decontamination. Follow-up investigations are planned over the next year to determine the requirements necessary to perform decontamination of large areas, including cleaning area to sustain cargo handling operations. Over the past year, the Services have worked together to improve the Joint orientation of NBC defense requirements. The work being accomplished will improve the equipment fielded in the near future. More emphasis needs to be placed on the Warfighting CINCs' requirements as input for equipment research and development. This is necessary to ensure that future equipment meets the needs of the Joint battlespace environment.**

Areas of concern which are addressed under the management improvement initiatives include the following:

- Focusing and prioritizing chemical and biological detector programs to ensure that resources are leveraging the most promising technologies and are not diluted by excessive Service unique requirements.

- Developing advanced individual protection ensembles which minimally degrade an individual's performance for all tasks performed in contaminated environments.

- Determining adequacy of funding for advanced decontamination systems, and review of requirements for large scale decontamination systems. Need to allocate or obtain sufficient funds to define requirements for large area decontamination.

- Identifying requirements for collective protection programs to ensure that enough assets are available to complete missions in a CB environment.

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